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Determinants of maternal mortality in Sub-Saharan Africa: a cause-effect model assessment

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Maternal mortality is considered one of the major challenges of population development worldwide. It has received extensive attention in the public health literature by both academics and health professionals over the past two decades. Many studies have focused on identifying why the death of a mother before delivery or after childbirth is still high in SSA (Sub-Saharan Africa) irrespective of the interventions that have been implemented by international bodies and governments in the region. This study uses PLS-SEM (partial least squares structural equation modelling) techniques, a multidimensional approach to integrate medical/health, socio-economic and socio-cultural determinants and assess the causal relationships among them and their effects on maternal mortality in Sub-Saharan Africa. The results of the authors' analysis show that the socio-cultural determinants have the greatest effect on the medical/health determinants. In the case of maternal mortality, medical/health determinants have the greatest impact, followed by socio-economic determinants. The socio-cultural determinants have both a direct and indirect effect on maternal mortality. The findings reveal that by integrating the medical/health, socio-economic and social cultural determinants in intervention policies that address the problem of maternal mortality, the high rate of maternal mortality in the Sub-Saharan region can be reduced.

KEYWORDS: PLS, maternal mortality, Sub-Saharan Africa

The number of deaths or health complications of a mother while pregnant, during delivery, immediately after delivery, or possibly within 42 days of the termination of pregnancy (*WHO* [2005]) is still very high despite the significant interventions of the UN (United Nations) since the late 1980s.

According to the UN Millennium Project report, 529,000 women die each year worldwide from pregnancy-related complications; about 90% are in developing countries, with the worst rate being in Africa (*UN* [2006]). The statistics from the *UNDP* (United Nations Development Programme) [2018] report that Africa has the highest maternal mortality rate, with SSA mainly responsible for the abysmal maternal death rate in the region, accounting for 53% of the global maternal deaths in 2017. The death of a mother during pregnancy is seen as a misfortune, and, over the years, it has become a burden for governments in SSA where international organizations have attempted to help address it through many interventions. In 1987, the international SMI (Safe Motherhood Initiative) was launched in Nairobi, Kenya. Its sole aim was to reduce the problem of maternal death and ill health in developing countries such as SSA. Most countries in the region took a keen interest in the initiative and worked out several policy programs to help achieve a reduction in maternal deaths. However, developing countries, including the SSA region, could not achieve the set targets reducing maternal death by 50% (*Starrs* [1987]).

Recently, many studies have focused on identifying the reasons why maternal mortality keeps rising irrespective of the interventions initiated. A number of antecedent factors, such as inadequate medical/health-related care services and socio-cultural and economic barriers, have been identified (*Adeusei et al.* [2014]). Most extant studies look at the medical explanatory variables alone or only mention the socio-cultural factors (*Senah* [2003], *Agan et al.* [2010], *Gumanga et al.* [2011], *Yego et al.* [2013]). However, the problem of maternal mortality may be due to the combination of several (socio-cultural, socio-economic, health care services, etc.) factors. As such, there is a need to study not only medical/health factors but also others. There is still a gap in the research on medical/health, socio-economic and socio-cultural determinants of maternal mortality in SSA.

Against this backdrop, our study empirically examines the maternal mortality problem by applying a structural model that incorporates social, cultural, economic and medical/health-related determinants. Further, it identifies the causal relationships among these determinants and their effects on maternal mortality in SSA. We use PLS-SEM estimation techniques that do not impose distribution on variables, and multidimensional measurement to determine the causal relationships among the constructs[1]. The rest of the paper is organized as follows. Section 1 discusses the theoretical and empirical review of the determinants of maternal mortality. Section 2 focuses on the methodological framework of the study. Section 3 examines and discusses the results and other major findings, while Section 4 presents our conclusion and policy implications.

[1] In the study, 'construct' is used as the equivalent of 'latent variable'.

1. Literature review

Maternal mortality, in general, refers to the death of a woman due to pregnancy and childbirth (*WHO* [1999]). In 2005, the *WHO* (World Health Organization) defined it as *the death of a woman while pregnant or within 42 days of termination of pregnancy or delivery from any cause irrespective of the duration and site of the pregnancy, or its management but not from a complication that is accidental or incidental* (*WHO* [2005] p. 169). According to *Nicholas* [2007], the definition of maternal mortality identifies maternal deaths based on their causes as either direct or indirect (*WHO–UNICEF–UNFPA–World Bank* [2012]). Direct maternal deaths primarily result from obstetric complications from pregnancy, namely, maternal deaths during pregnancy, delivery, or postpartum including complications from intervention omissions, incorrect treatment, or a sequence of events resulting from any of the aforementioned complications (*WHO* [2007]). Examples of direct causes include conditions such as bleeding (haemorrhage), infections, hypertensive disorders, unsafe abortions, and obstructed labour with bleeding. Indirect causes result from previously existing diseases that develop before or during pregnancy but are not unique to direct pregnancy causes; they include anaemia, malaria, tuberculosis, heart disease, and other conditions aggravated by the physiological effects of pregnancy.

The CMACE (Centre for Maternal and Child Enquiries) in the United Kingdom has also adopted the definition of maternal mortality from the WHO. However, unlike *Nicholas* [2007], it classifies the causes of maternal mortality into four main areas. These are based on time (i.e. during pregnancy and within 42 days after birth); direct causes, namely, obstetric conditions; indirect causes; and coincidental (i.e. accidents) and late deaths (*Cantwell et al.* [2011]). In the *WHO* [2004] report, late maternal deaths are deaths occurring six weeks to one year after the birth. The definition is recognised more frequently in countries with more advanced and well-structured health registration systems and technology for life-sustaining procedures, where women can survive maternal complications beyond 42 days in the postpartum period. The *WHO*'s [1999] definition that limits maternal deaths up to 42 days in the postpartum period is mainly for developing countries based on an under-development of healthcare technology (*WHO* [2004]).

1.1. Theoretical review

To understand how the direct and indirect factors influence maternal mortality, *McCarthy* and *Maine* developed a framework [1992] to analyse the determinants of maternal mortality. They considered the frameworks developed by *Davis* and

Blake [1956], *Bongaarts* [1978], and *Mosley* and *Chen* [1984]. *Davis* and *Blake* [1956] first developed their framework by classifying how intermediate variables, which are influenced by social factors, can affect the level of fertility. They conceptualized eight intermediate fertility variables, namely, proportion married, contraception, induced abortion, locational infecundity, frequency of intercourse, sterility, spontaneous intrauterine mortality, and duration of fertility. *Bongaarts* [1978] later reviewed this social structure and fertility analytical framework. In his research for analysing the proximate determinants of fertility, he reduced the eight intermediate fertility variables grouped by *Davis* and *Blake* [1956] to three. Its intermediate variables were exposure factors, deliberate fertility control factors, and natural marital fertility factors. *Mosley* and *Chen* [1984] also proposed an analytical framework to analyse child survival. In their framework, they used both the social and biological factors and incorporated methods employed by early social and medical scientists, such as *Davis* and *Blake* [1956] and *Bongaart*s [1978] to analyse child survival in developing countries. *McCarthy* and *Maine* [1992] reviewed the analytical research of earlier authors and included socio-cultural, unknown, and predicted factors in their framework. They conceptualized their determinants into three; namely, distant determinants, intermediate determinants, and health determinants. In their framework, the sequence of health outcomes involved pregnancy, implications, and disabilities. The intermediate determinants comprised health status, reproduction status, access to health services, health care behaviour, use of health care services, and unknown and predicted factors. The distant determinants were the socio-economic and socio-cultural status of the pregnant woman and her community. Our study adopts a modified framework based on *McCarthy* and *Maine* [1992] to analyse the determinants of maternal mortality in SSA. The determinants are conceptualised as medical/health, socio-cultural, and socio-economic factors.

1.2. Empirical review

Studies that analyse the determinants of maternal mortality have adopted some of the determinants of the framework of *McCarthy* and *Maine* [1992] as noted above. They focus on either the distant determinants (socio-economic and social-cultural) or the intermediate determinants (medical/health). An observational and case-control study by *Masturoh, Respatih* and *Murti* [2017] adopted the framework of *McCarthy* and *Maine* [1992] to analyse the determinants of maternal mortality. That study focused on intermediate (medical/health) determinants and socio-economic determinants. The results, using path analysis, indicated that antenatal coverage and obstetrical complications influenced the risk of maternal mortality in the Brebes district, Indonesia. They also observed that antenatal coverage was influenced by a higher level of education as well as the mother's job. Another study conducted by *Meh* [2017] on the determinants of maternal mortality in Cameroon used DHS (demographic and health surveys) data for 1991, 2004, and 2011. The author used a modification of *McCarthy* and *Maine*'s [1992] framework to analyse maternal mortality. The study focused on socio-economic, socio-cultural and intermediate (medical/health) determinants. Using a logistic regression, *Meh* showed that there were relationships among age, parity, education, and maternal mortality. The author's analysis also showed that there was a significant relationship between maternal mortality and distance to the medical/health facility in the northern part of Cameroon, and that maternal mortality was significantly associated with domestic violence and ethnicity.

Another ecological study conducted by *Girum* and *Wasie* [2017] on the determinants of maternal mortality using a sample of 82 developing countries with data from international databases focused on socio-cultural, socio-economic and intermediate (medical/health) determinants between 2008 and 2016. Their study showed that the maternal mortality ratio significantly correlated with antenatal coverage, skilled birth attendance, access to improved water and sanitation, adult literacy, and GNI (gross national income) per capita inversely. Their analysis further showed that there was a significant relationship between the maternal mortality ratio and socio-economic indicators, health care, and morbidity.

Using data from 2001 to 2008 in different provinces, *Zolala et al.* [2012] studied the determinants of maternal mortality in Iran. The results of the multiple regression analysis showed that male literacy and employment were related significantly and inversely to maternal mortality. The analysis further showed that there was a slightly significant association between maternal mortality and the proportion of midwives. The studied variables included socio-economic, socio-cultural and intermediate (medical/health) determinants.

Alvarez et al. [2009] conducted a multi-ecological study on 45 SSA countries using data from international databases such as the World Bank, WHO, UNDP, and UNICEF (United Nations Children's Fund) between 1997 and 2006. Their study focused on intermediate (medical/health), socio-cultural and socio-economic determinants. The result from their regression analysis established a relationship among the socio-economic and the socio-cultural determinants and the maternal mortality ratio.

Buor and *Bream* [2004] examined the determinants of maternal mortality in SSA. They focused on intermediate (medical/health) and socio-economic determinants using data for 28 countries from international databases such as the World Bank, UNAIDS (Joint United Nations Program on HIV/AIDS), the UN, DHS, international and national statistical offices. Their study used bivariate correlation and other non-parametric analyses, such as Kendall's tau-c values and regression, to establish a relationship between the determinants and the maternal mortality ratio. The result showed a significant relationship between GNP (gross national product) per capita, life expectancy, health expenditure, and maternal mortality.

2. Methodology

In this section, we discuss the interactions among the determinants and their effect on maternal mortality using PLS path analysis. In the PLS analysis, a factor and regression analysis are run simultaneously, enabling us to analyse the direct and indirect effects of the latent constructs. The PLS-SEM technique was chosen because it can be used in cases of small sample sizes and non-normally distributed variables (*Hair et al.* [2012]). Thus, it will give meaningful results even when the sample size is very small (*Chin–Newsted* [1999]). The PLS path analysis with the smartPLS3 software is used to estimate both the measurement model (that represent the relationship between each constructs and its associated indicators) and the structural model (that represent the structural path between constructs). The internal consistency of the model is measured by the composite reliability. The convergence validity of the specified model is assessed using indicator reliability and average variance explained and discriminant validity. The structural or inner model is evaluated using the Pearson coefficient, R^2 (the coefficient of determination) which measures the percentage of the given construct that can be explained by the other dependent constructs and the independent variables affecting it; the f^2 measures the size of the variable effect (*Chin–Marcolin–Newsted* [1996]). The latent variables and their manifesting variables are presented in Table 1.

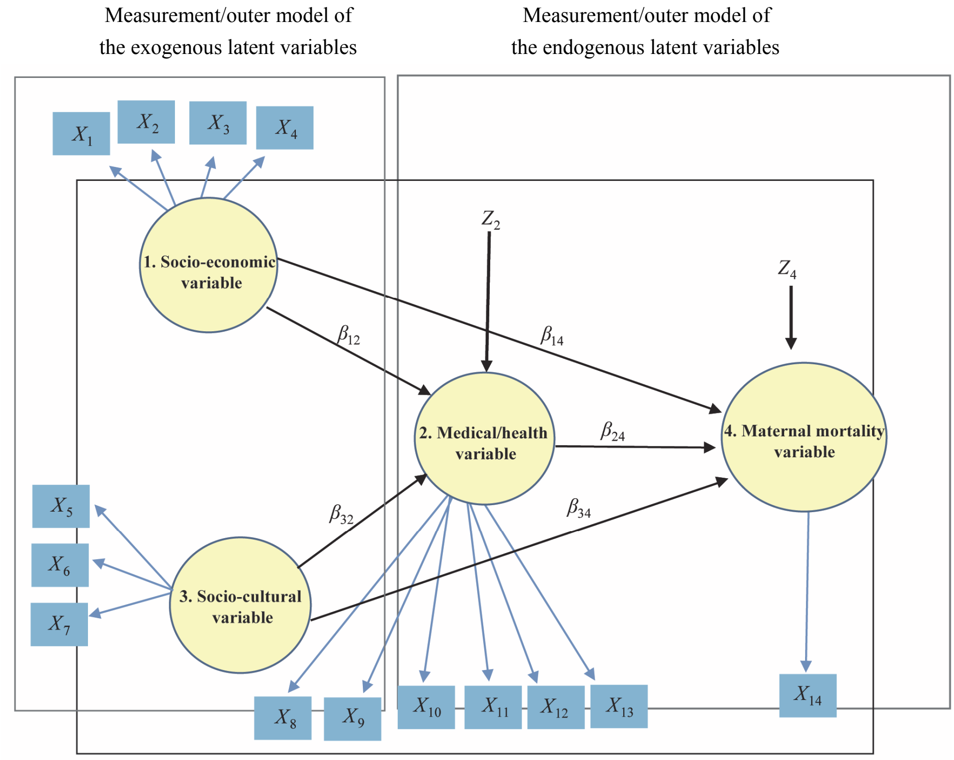
Table 1

Latent variables and their manifesting variables

Latent variable	Manifest variable
Maternal mortality variable	Maternal mortality ratio
Socio-economic variable	GNI per capita
	Female occupation
	Female unemployment
	Education index
Socio-cultural variable	Female literacy
	Female secondary education
	Gender index
Medical/health variable	Antenatal coverage
	Skilled birth attendant
	Access to improved water source
	Contraceptive prevalence rate
	Life expectancy at birth
	Total fertility rate

Note. GNI: gross national income.

Figure 1. Proposed structural model for analysing the determinants of maternal mortality



Note. $X_{1\text{–}14}$: manifest variables; Z_2 and Z_4: error terms that reflect the sources of variance in the structural model, not captured by the respective antecedent construct(s). β-s refer to the strength of the relationships between latent variables.

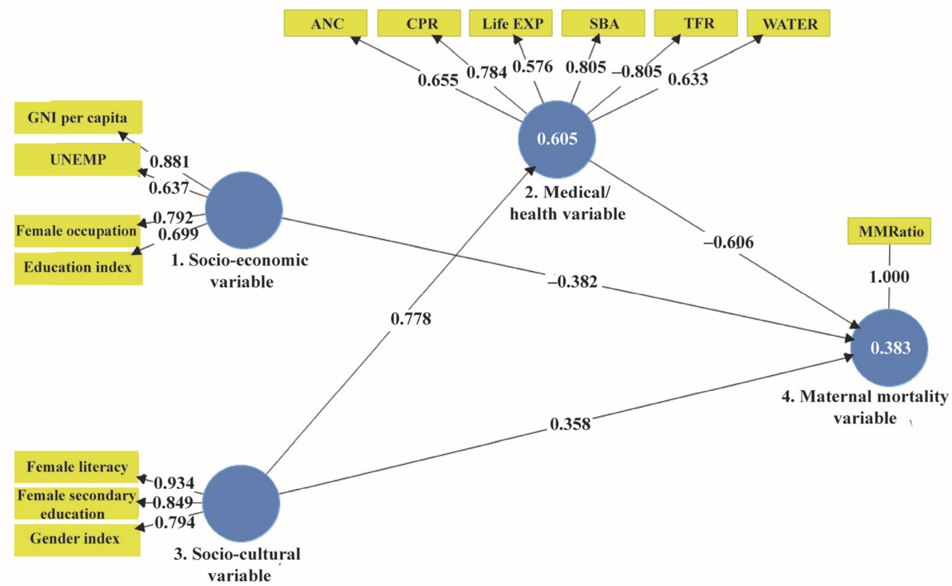
2.1. Data source

The data in our study are primarily secondary drawn from the World Bank (World Development Indicators) and UN online databases such as UNICEF, DHS, and UNDP. The dataset was crosschecked with other various sources, such as the WHO, international and country statistical offices, for consistency and were proven to be consistent before being used in the analysis. The dataset consisted of cross-sectional data from 2008 to 2015 for 35 SSA countries.

3. Empirical results and discussion

The validity of the structural model is determined by the R^2. The coefficient measures the percentage of the variance in the endogenous variable explained by the structural model. (See Figure 2.) Thus, it represents the quality of the adjusted model. The analysis in Table 3 shows that the variance explained by the endogenous medical/health latent construct is 60.5% and by the maternal mortality latent variable is 38.3%. According to *Cohen* [1988], an R^2 of 2% in social and behavioural sciences is considered a small effect while 13% and 26% are classified as medium and large effects, respectively. Based on *Cohen*'s [1988] classification, we conclude that the endogenous latent variables medical/health and maternal mortality have a large effect in our model.

Figure 2. Our final model for analysing the determinants of maternal mortality in Sub-Saharan Africa



Note. ANC: antenatal coverage; CPR: contraceptive prevalence rate; Life EXP: life expectancy at birth; SBA: skilled birth attendant; TFR: total fertility rate; WATER: access to improved water source; UNEMP: female unemployment; MMRatio: maternal mortality ratio.

In Table 2, the predictive validity values of 0.275 for the endogenous latent construct medical/health and 0.268 for the maternal mortality variable are greater than zero (that is, our path model's predictive accuracy is acceptable; see *Hair et al.*

[2014]). The effect size (f^2) which evaluates how useful each construct is to the adjustment of the proposed model is medium for the latent construct socio-cultural and large for the medical/health and socio-economic variables (i.e. 0.291, 0.323, and 0.462, respectively; see Table 2). The results show that the endogenous (medical/health and maternal mortality) variables are useful in the adjustment of the proposed model.

Table 2

Indicator validity and effective predictive size

Latent variable	Validity (Q^2)	Effect size (f^2)
Medical/health variable	0.275	0.323
Maternal mortality variable	0.268	–
Socio-economic variable	–	0.462
Socio-cultural variable	–	0.291

Note. Evaluation criteria: $Q^2 > 0$; 0.02, 0.15, and 0.35 are considered small, medium, and large effects, respectively (*Hair et al*. [2014]).

As indicators for the adjustment quality of the model, *AVE* (average variance explained), *CR* (composite reliability) and R^2 are used. Instead of Cronbach's alpha, we chose the *CR* as it is most fitting for PLS analysis; it orders the variables according to their reliability. In Table 3, *AVE* is greater than 0.5, *CR* is greater than 0.7, thus they are adequate for the construct, validating the model according to *Hair et al*. [2009].

Table 3

Indicators for the adjustment quality of the model

Latent variable	*AVE*	*CR*	R^2
Medical/health variable	0.515	0.705	0.605
Maternal mortality variable	1.000	1.000	0.383
Socio-economic variable	0.741	0.895	–
Socio-cultural variable	0.531	0.847	–

Note. *AVE*: average variance explained; *CR*: composite reliability. Evaluation criteria: $AVE > 0.5$ and $CR > 0.7$.

Table 4 reports the discriminant validity based on the Fornell-Larcker criterion, an indicator to assess the validity of the structural model. According to *Fornell* and *Larcker* [1981], for the validity of the structural model, the square root of the average variance explained by each construct should be greater than its absolute correlation coefficient with the other constructs. The discriminant value is obtained by finding the square root of the *AVE* of the latent constructs, shown on the main diagonal, and comparing the value to its correlation coefficient in each column. The results show that the square root of the *AVE* for all latent constructs is higher than the absolute values of the correlation coefficients of the constructs, except for one case (the correlation coefficient of the socio-economic–medical/health constructs [$r = 0.778$] is higher than the square root of the *AVE* [0.718]). In this case, we also used another method to analyse the discriminant validity. We checked cross loadings between the manifest variables and these constructs, which show the correlations between manifests and constructs. The result of this analysis show that there is no problem with the discriminant validity. Based on the above analysis, we conclude that the discriminant validity of the measurement model exists.

Table 4

Discriminant reliability for latent variables

Latent variable	Discriminant value			
	Medical/health	Maternal mortality	Socio-economic	Socio-cultural
Medical/health variable	0.718			
Maternal mortality variable	–0.538	1.000		
Socio-economic variable	0.778	–0.359	0.861	
Socio-cultural variable	0.548	–0.485	0.637	0.729

Table 5

Bootstrapping algorithm results for path coefficients

Casual relation	Original sample	Sample mean	Standard deviation	Test statistics	*p*-value
Medical/health–Maternal mortality	–0.606	–0.625	0.241	2.511	0.012
Socio-cultural–Medical/health	0.778	0.802	0.050	15.423	0.000
Socio-cultural–Maternal mortality	0.358	0.382	0.178	2.004	0.046
Socio-economic–Maternal mortality	–0.382	–0.401	0.154	2.477	0.014

The significance of the path coefficient is tested using a bootstrapping algorithm. The number of sub-samples used for the bootstrapping was 5,000 based on the assumptions of *Hair*, *Ringle* and *Sarstedt* [2011]. Table 5 shows that the socio-cultural exogenous latent construct has a positive relation with the maternal mortality and the medical/health construct, while the socio-economic construct has a negative relation with maternal mortality. (See Figure 2 for the path coefficient of the constructs and their direct effects.)

According to Table 6, the total effect of the socio-cultural construct on the medical/health construct comprises solely its direct effect on it ($\beta = 0.788$). The medical/health construct and the socio-economic construct also have only a direct effect on maternal mortality ($\beta = –0.606$, $\beta = –0.382$, respectively). The total effect of the socio-cultural construct on maternal mortality ($\beta = –0.114$) is the sum of its direct ($\beta = 0.358$) and indirect effects ($\beta = –0.472 = –0.606 * 0.778$; this latter is made through the medical/health construct).

Table 6

Total effect and significance testing in the model

Casual relation	Original sample	Sample mean	Standard deviation	Test statistics	*p*-value
Medical/health–Maternal mortality	–0.606	–0.625	0.241	2.511	0.012
Socio-cultural–Medical/health	0.778	0.802	0.050	15.423	0.000
Socio-cultural–Maternal mortality	–0.114	–0.118	0.143	0.795	0.427
Socio-economic–Maternal mortality	–0.382	–0.401	0.154	2.477	0.014

Note. Significance level: 0.05.

Table 7 presents the total indirect effect of the on maternal mortality ($\beta = –0.472$), which comes from the direct effect of the socio-cultural construct on the medical/health construct and the direct effect of the medical/health construct on maternal mortality – as it was mentioned earlier.

Table 7

Indirect effect and significance testing in the model

Casual relation	Original sample	Sample mean	Standard deviation	Test statistics	*p*-value
Medical/health–Maternal mortality	–	–	–	–	–
Socio-cultural–Medical/health	–0.472	–0.500	0.197	2.392	0.000
Socio-cultural–Maternal mortality	–	–	–	–	–
Socio-economic–Maternal mortality	–	–	–	–	–

Note. Significance level: 0.00.

4. Conclusions and policy recommendations

The study examined the causal relationships among determinants of maternal mortality and their effects on maternal mortality by applying PLS-SEM modelling to cross-sectional data from international databases, spanning 2008 to 2015. The model structure and measurements were verified for the causal model. (See Figure 2.) The verification of the latent constructs was performed by examining convergence validity, *AVE*, *CR*, and factor loading (*Hair* [2009]). The results in Table 3 show that $CR > 0.7$ and $AVE > 0.5$ for each latent variable and that the factor loadings are greater than 0.5, thus, all the factor loadings for the constructs are reliable. The discriminant validity was justified by Table 4 as the discriminant values of the latent variables are greater than the square of the correlation between the latent and other constructs (for the criterion, see *Fornell–Larcker* [1981]).

The analysis of the validity of the structural model in Table 2 showed that the latent constructs, maternal mortality and medical/health, had higher predictive relevance since the predictive validity $\left(Q^2\right) > 0$ and that the effect size $\left(f^2\right)$ for the latent medical/health, socio-economic and socio-cultural constructs were considered medium and large (for f^2 values, see *Hair et al*. [2014]). According to the R^2 results, maternal mortality is affected by three latent constructs, namely, medical/health, socio-economic and socio-cultural. This means they explain 60.5% of the variance of maternal mortality. The latent construct medical/health is also affected by the socio-cultural and socio-economic constructs with a R^2 value of 0.383, that is, 38.3% of the variation in the medical/health latent construct is explained by these two latent constructs.

The results for the total effects of the latent constructs on maternal mortality shows that the medical/health latent construct ($\beta = -0.606$, $p = 0.012$) has a negative and statistically significant effect on maternal mortality. It is associated with inadequate health care facilities, inadequate number of health care professionals with sufficient training to provide required health care services, and poor health behaviour on the part of pregnant mothers. Studies have shown that women who attend care during early and late pregnancy stages versus those who do not attend such care differ in factors e.g. education, unwanted pregnancy, and maternal age, among others that affect pregnancy outcomes (*Thomas–Golding–Peter* [1991]). The path coefficient, that is, the total effect of the socio-economic latent construct ($\beta = -0.382$, $p = 0.014$) on maternal mortality is greater than the total effect of the socio-cultural construct on maternal mortality ($\beta = 0.382$, $p = 0.427$), which is negative and not significant. The effect of the socio-economic latent construct on maternal mortality is negative and statistically significant. The socio-cultural latent construct has the greatest effect, and this effect is on the medical/health latent construct. It is due to cultural and religious beliefs associated with the use of modern medical care, female literacy, and gender inequality in accessing medical care in Africa where SSA is not an exception. (*Malhotra–Schuler* [2005], *Das Gupta* [1990], *Gibbs et al.* [2012], *Obse–Mossie–Gobena* [2013]).

Our results also show that the socio-cultural latent construct has both direct and indirect effects on maternal mortality. Its indirect effect manifested through the medical/health variable is, however, greater ($\beta = -0.472$) than its direct effect ($\beta = 0.358$), thus the total effect ($\beta = -0.114$, $p = 0.427$) is negative and not significant. Its significant direct effect on maternal mortality is associated with low-economic status, which relates to lack of access to health care and less utilisation of health care delivery services; these factors result in poor health outcomes (*Ahnquist–Wamala–Lindstrom* [2012], *Pickett–Pearl* [2001]). Poverty also contributes to this effect since it prevents women, especially pregnant women, from receiving proper and sufficient medical attention due to their inability to afford good antenatal and prenatal care services. The PLS-SEM results show that there is value in integrating the socio-economic, socio-cultural and medical determinants in models to assess their effects on maternal mortality. To reduce maternal mortality in SSA, policies and interventions should focus on these three determinants. Our results confirm the results in the studies by *Girum–Wasie* [2017] and *Azuh et al*. [2017], which show that the medical/health, socio-economic and socio-cultural determinants have a significant effect on maternal mortality.

Our study highlights the need for government and policymakers to integrate the socio-cultural, socio-economic and medical/health determinants in policies aimed at reducing maternal mortality in SSA. Governments in the region should improve easy access to and use of the health systems and train more health professionals in quality health care delivery. Political leaders in the region should initiate economic programmes that will improve the socio-economic conditions of pregnant mothers and their families. Moreover, governments, opinion leaders and policymakers should enforce the policies aimed at abolishing harmful cultural practices against women in the region.

Appendix

Description of variables

Variable	Description	Source
Maternal mortality ratio	The number of women who die from pregnancy-related causes while pregnant or within 42 days of pregnancy termination per 100,000 live births	WDI
	Socio-economic	
GNI per capita (Atlas method)	Gross national income (in US dollars) divided by midyear population	WDI World Bank
Female occupation	Percentage of women occupying middle and senior positions	DHS
Female unemployment	Percentage of female labour force that is without work but available for and seeking employment	WDI
Education index	The average of mean years of schooling of adults and expected years of schooling for children, the two expressed as an index obtained by scaling with the corresponding maximum	UNDP
	Socio-cultural	
Female literacy	Percentage of female population aged 15 and above who can read, write, and understand a short simple statement about their everyday life	DHS
Female secondary education	Percentage of female population aged 15–49 with secondary education and above	DHS
Gender deviation index	The ratio of female to male human development value	UNDP
	Medical/health	
Antenatal care coverage	Percentage of women aged 15–49 that were attended at least once during pregnancy by skilled health personnel (doctor, nurse, or midwife)	DHS
Skilled birth attendant	Percentage of births that received care from qualified medical personnel	DHS
Access to improved water source	The percentage of population using an improved drinking water source	UNDP
Contraceptive prevalence rate	The percentage of women aged 15–49 years, married or in-union, who are currently using, or whose sexual partner is using, at least one method of contraception	WDI
Life expectancy at birth	The number of years a new-born would live if prevailing patterns of mortality at the time of his/her birth were to stay the same throughout its life	WDI
Total fertility rate	The average number of children a hypothetical cohort of women would have at the end of their reproductive period if they were subject during their whole lives to the fertility rates of a given period and if they were not subject to mortality	WDI

Note. WDI: World Development Indicators; DHS: demographic and health surveys; UNDP: United Nations Development Programme.

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